

Message to World Magnetic Model (WMM) Users

NOAA/NCEI – March 21, 2018

This is to inform users that the WMM Gridded Variation (GV) error has recently exceeded the performance specification in the Arctic region. Other geographic areas and other model parameters are not affected. The increased GV error may adversely affect compass navigation in those areas. We invite your feedback on potential impacts and whether an out-of-cycle WMM update would benefit your operations.

Background

- The World Magnetic Model (WMM) is a standard model used for navigation, attitude and heading referencing systems using the geomagnetic field.
- The World Magnetic Model (WMM) is a spherical harmonic model of the Earth's main (mostly core generated) magnetic field and its secular (slow temporal) change. The latest WMM was released in December 2014 and is valid until December 31, 2019.
- The main field changes in time due to fluid flows in the Earth's outer core. Given our current state of knowledge, these flows are largely unpredictable.
- Grid variation values generated by the WMM and its software implementations have a goal of errors smaller than 1.0° RMS at sea level in the polar regions – the portion of the Earth where the latitude is above 55°N or below 55°S – at any time during the entire 5-year lifetime of the model.
- The grid variation (GV) error is the same as the magnetic declination (D) error at latitudes above 55°N or below 55°S.
- The Geomagnetism team at NOAA National Centers for Environmental Information (NCEI) regularly assesses the WMM performance by comparing it with more recent models calculated from satellite data and with ground-based observatory data.

Findings

- ***The WMM GV error is currently above the WMM performance specification. Its current value (as of February 2018) is 1.5° root-mean-square (RMS) in the Northern polar cap.***
- Assuming a constant secular variation in the coming years, the GV error in the Northern polar cap is expected to cumulatively increase until it reaches 2.02° RMS by December 31, 2019 (end of current WMM period of validity, see Figure 1).
- The GV error is largest in the Canadian Arctic Archipelago, Northern Greenland, parts of Northern Siberia, a large portion of Arctic Ocean and the Laptev Sea (Figure 2).
- The GV error is within specification in the Southern polar cap. Other areas are not affected.
- This performance degradation is caused by fast-changing core flows in the North polar region of the Earth's outer core.

Next steps

NOAA/NCEI may provide an out-of-cycle WMM update later in 2018 to bring the GV error back within specification. To help NOAA decide whether to immediately release an out-of-cycle WMM, we encourage you to respond to our following questionnaire as an email to geomag.models@noaa.gov.

1. Is your operational mission affected by the increased error of WMM (Yes/No)?
2. If yes, how does this additional error impact your mission? Be as specific as you can. Name the platform/system/software that uses WMM.
3. The next WMM is scheduled to be released in December 2019. Do you require an earlier, out-of-cycle WMM update to address this error issue?
4. If yes, would you use the online API or the downloadable WMM software?
5. Any challenges (technical, cost, etc.) that might prevent you from using an out-of-cycle update of the WMM?

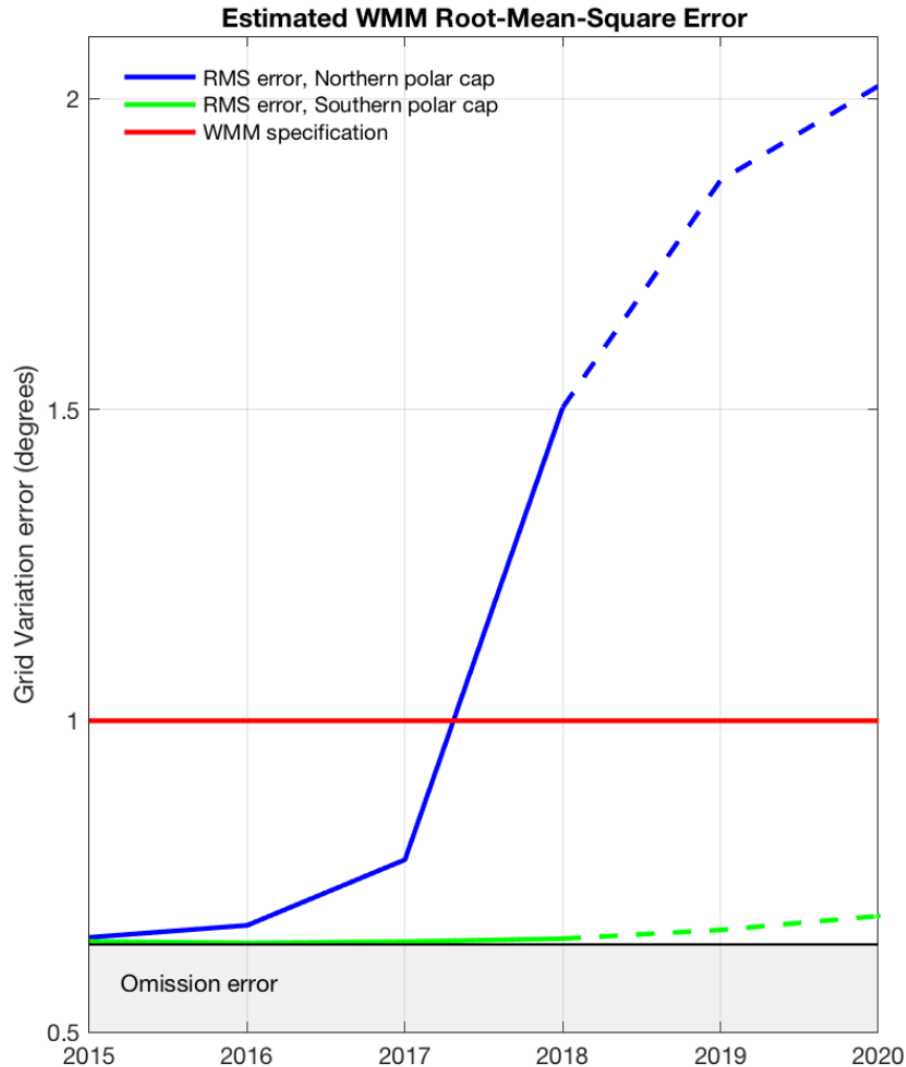


Figure 1: Temporal evolution of the WMM GV error in both polar caps during the current WMM cycle (2015-2020). The omission error is caused by un-modeled crustal and external magnetic fields and is the floor from which the WMM grows during each cycle as the secular variation departs from its linear prediction.

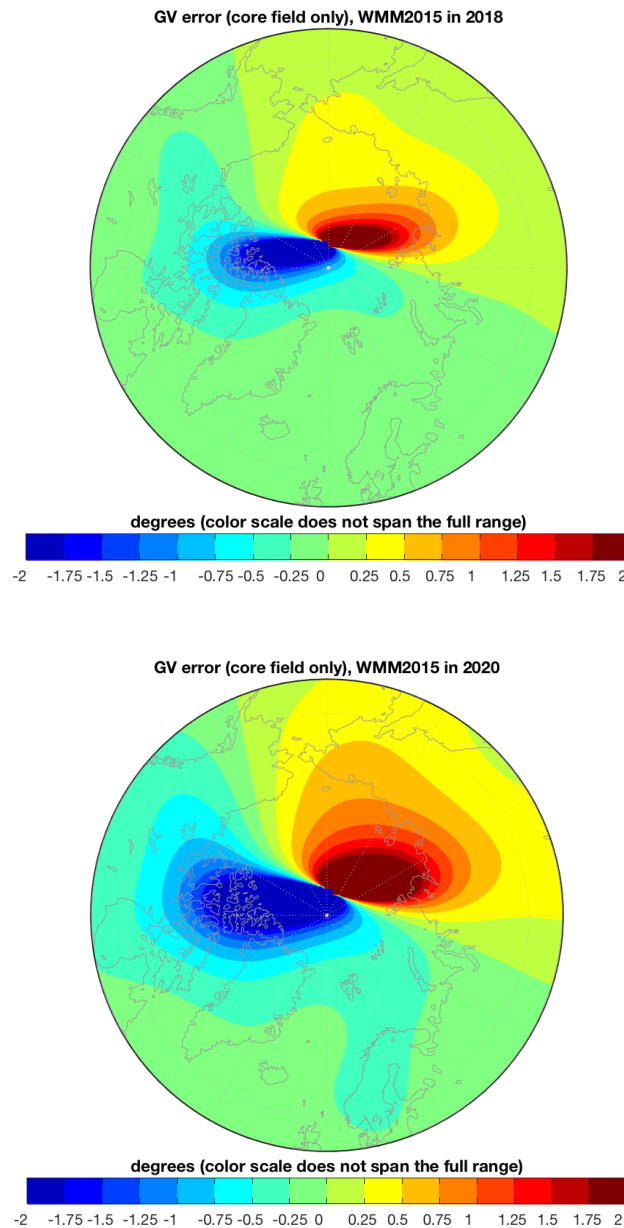


Figure 2: WMM GV error due to secular variation in the Northern polar cap (latitude above 55°N) in 2018.0 (top) and 2020.0 (bottom). The total error (1.5° RMS in 2018.0, 2.02° RMS in 2020.0, see Figure 1) is obtained by adding this error to the omission error (0.64° RMS).

References

Chulliat, A., S. Macmillan, P. Alken, C. Beggan, M. Nair, B. Hamilton, A. Woods, V. Ridley, S. Maus and A. Thomson, 2015. *The US/UK World Magnetic Model for 2015-2020: Technical Report*, NOAA National Geophysical Data Center, Boulder, CO, doi: [10.7289/V5TB14V7](https://doi.org/10.7289/V5TB14V7).